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Asset Location for Retirement Savers

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Deciding how much of a portfolio to allocate to different types of assets is one of the fundamental issues in financial economics. For taxable individual investors, the proliferation of tax-deferred vehicles for retirement saving, such as individual retirement accounts (IRAs), 401(k) plans, Keogh plans, and 403(b) plans, has added a new dimension to the historical asset allocation problem. A taxable investor needs to make choices not just about the amount to hold in various assets but also about *where* to hold those assets. If there are two asset classes, broadly defined as riskless and risky, the asset allocation problem facing tax-exempt investors involves choosing only the fraction of the portfolio to allocate to the risky asset. Taxable investors with a tax-deferred retirement saving account, however, face a more complex problem, since they must decide how much of the risky asset to hold in their tax-deferred account and how much to hold in their taxable account. Shoven (1999), Shoven and Sialm (2004), and Dammon, Spatt, and Zhang (2004) labeled the problem of deciding where to hold a given asset the asset *location* decision.

Poterba, Venti, and Wise (2000) have shown that more than 30 million workers currently participate in 401(k) pension plans; millions more have tax-

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deferred assets in IRAs. Virtually all 401(k) plans—and all IRAs—give account holders substantial discretion in choosing the set of assets that they hold. Therefore most account holders who also have other assets outside the tax-deferred accounts face asset location choices. The choices are likely to be most salient for middle- and upper-middle-income households whose tax-deferred assets represent a substantial fraction, but not all, of their financial wealth. Recent legislation prospectively increasing the limits on contributions to tax-deferred retirement saving plans could make the asset location decision more significant for households in higher income and wealth strata, since the legislation will increase the total pool of assets that a household can accumulate in a tax-deferred setting.

How holding an asset in a taxable or tax-deferred account affects long-term wealth accumulation depends on the tax treatment of the asset in question as well as on the other assets available. Given a set of assets that an investor wishes to hold, long-run wealth accumulation generally will be maximized by placing the most heavily taxed assets in the tax-deferred account (TDA) while holding the less heavily taxed assets in the taxable account. We refer to the latter as the conventional savings account (CSA).

The asset location problem is a practical question in applied financial economics that confronts many households as they save for retirement and other objectives. Yet much of the conventional wisdom on asset location for individual investors derives from research on a related problem confronting corporations. Two decades ago, Black (1980) and Tepper (1981) studied the problem of asset allocation for a corporation that could choose to hold its assets in its defined benefit pension plan or in its taxable corporate account. They explored corporate asset location problems with respect to taxable bonds and corporate equities. Taxable bonds were assumed to generate heavily taxed interest income, and corporate equities were assumed to generate lightly taxed returns because capital gains are not taxed until they are realized. The studies concluded that because bonds are taxed more heavily than stocks, a firm could maximize shareholders' after-tax cash flow by placing bonds in the pension account and stocks in the taxable corporate account. The pension account in the corporate setting is equivalent to an individual investor's tax-deferred account. Something like that analysis underlies the suggestion, made by many financial advisers, that individual investors should allocate taxable bonds to their tax-deferred account before holding any such bonds in their taxable account.

However, that analysis neglects two important aspects of the investment decisions that face many taxable investors. First, heavily taxed corporate or government bonds are not the only way for taxable investors to participate in the market for fixed-income securities; they also can choose to hold tax-exempt bonds. Over the last four decades, the average yield on long-term tax-exempt bonds has

exceeded the after-tax yield on taxable Treasury bonds for individual investors in the highest marginal tax brackets. Tax-exempt bonds therefore offer taxable investors the potential to hold fixed-income securities with an implicit tax rate that may be lower than the statutory tax rate on taxable bonds.

The second shortcoming of the conventional asset location analysis is that it assumes that investments in corporate stock are lightly taxed. In practice, many taxable investors hold equities through equity mutual funds. Many equity funds, particularly actively managed ones, are managed in a fashion that imposes substantial tax burdens on taxable individual investors. Dickson and Shoven (1995), Dickson, Shoven, and Sialm (2000), Bergstresser and Poterba (2002), Arnott, Berkin, and Ye (2000), and others have computed before-tax and after-tax returns for equity mutual funds in the United States. Their studies suggest that such funds often realize capital gains more quickly than might be desirable if the objective is to defer taxes. Therefore the effective tax rate on equity investments through mutual funds often is substantially greater than that on a buy-and-hold equity portfolio.

Omitting tax-exempt bonds from the asset location analysis and failing to recognize that many investors hold their equities in actively managed mutual funds combine to overstate the tax burden on fixed-income assets compared with that on equities. In this chapter, we investigate whether those two factors are important enough to reverse the conventional wisdom, exploring whether historically investors would have accumulated more after-tax wealth by holding equity mutual funds in a tax-deferred account and municipal bonds in a taxable account than by holding taxable bonds in a tax-deferred account and equity mutual funds in a taxable account.

We use the historical performance of mutual funds to explore the asset location problem. Earlier work on asset location was either theoretical or used hypothetical or simulated mutual funds.[1] Although using historical data provides information on how investors following alternative investment strategies would have fared in past decades, historical data may not describe the future. It is possible that in the future actively managed equity mutual funds may impose lower tax burdens on their investors than they have in the past.

We consider a stylized investor who made equal annual contributions to a tax-deferred account and a conventional savings account over the period 1962–98. We assume that the investor rebalanced his or her portfolio each year to hold half of the total assets in equities and half in fixed-income investments. We also assume that all equity investments were made in one of a set of equity mutual funds for which we collected historical returns and that fixed-income investments could be made in tax-exempt as well as taxable bonds.

1. See Shoven and Sialm (2004), Shoven (1999), and Shoven and Sialm (1998).

We compute the investor's after-tax wealth at the end of 1998 under two different asset location strategies. The first, Defer Stocks First, specified that investments in one of the equity mutual funds in our data set would be given priority for placement in the tax-deferred account. Under that rule, if the total market value of the assets in the TDA were less than half of the combined market value of the assets in the TDA and the CSA, the investor would hold only an equity mutual fund in the tax-deferred account. If the total amount that the investor could hold in the TDA were more than half of the combined value of the TDA and the CSA, then the TDA would hold some fixed-income instruments and the CSA would hold only fixed-income instruments. That would involve holding some taxable bonds in the TDA and tax-exempt bonds in the CSA.

The second asset location strategy, Defer Bonds First, reversed that order. Fixed-income assets were held in the TDA before any such assets were held in a taxable format. In this case, if the total value of the TDA assets were less than half of the combined value of the TDA and the CSA, the investor would hold only taxable bonds in the TDA.

In this chapter, we first describe a simplified one-period model of asset location. While we can find clear results analytically for a one-period asset location problem, we cannot do this for a multiperiod problem; we therefore develop numerical results on the consequences of different asset location decisions for hypothetical multiperiod investors. Next we describe the data on equity mutual fund returns and bond returns underlying our calculations and give our assumptions about the marginal tax rates facing our hypothetical taxable investors. We then present our core findings on the amount of wealth that investors would have accumulated if they had followed the two different asset location strategies over the 1962–98 period. For virtually all of the actively managed mutual funds in our data set, an investor would have had more end of period wealth if he had allocated his mutual fund shares to his tax-deferred account before holding equity mutual funds in his conventional saving account. The differences in end of period wealth between the two asset location strategies are substantial for all of the actively managed funds in our data sample. The differences are much smaller for equity index funds. Our findings stand in contrast to much conventional wisdom, due both to our recognition of the opportunity to hold tax-exempt bonds and to the higher tax burden on corporate stock that follows from holding equities through mutual funds rather than directly.

We also explore the sensitivity of our findings to the particular pattern of equity and bond returns that has characterized the last four decades. We evaluate the robustness of our findings by drawing sequences of thirty-seven returns (with replacement) from each fund's empirical distribution of returns. Our results suggest that while the recent history of returns has been particularly favorable to the Defer Stocks First strategy, for most random draws from the

return distribution for the last four decades, this strategy would have generated more after-tax wealth than the Defer Bonds First strategy.

We last introduce inflation-indexed bonds such as Treasury inflation-protected securities (TIPS), which have been available in the United States since 1997. Our analysis assumes that inflation-indexed bonds with a 4 percent real return were available throughout the 1962–98 period. We show that in this case, holding equity mutual funds in the TDA and inflation-indexed savings bonds in the CSA would have given investors a higher expected utility than holding equity mutual funds in their TDA and tax-exempt nominal bonds in their CSA. The chapter concludes with a summary of our findings.

Asset Location in a Simple Setting

Our analysis begins with a one-period example illustrating the effects of asset location on investor returns. We suppose that an investor can hold taxable bonds (B), tax-exempt municipal bonds (M), and stocks (S) in a conventional savings account (CSA) or in a tax-deferred account (TDA). The pretax returns of the three asset classes are r_B, r_M, and r_S, where the bond returns are nonstochastic and satisfy $0 < r_M < r_B$. We assume the effective tax rate of stocks to be lower than the effective tax rate of taxable bonds: $\tau_S < \tau_B$. The implicit municipal bond tax rate equals $\tau_M = 1 - r_M/r_B$. For simplicity, we assume that the tax rates do not change over time, which means that the return on an investment in a TDA equals the before-tax return $r^{TDA} = r$. The after-tax return on taxable assets in a CSA equals $r^{CSA} = (1 - \tau)r$. We take the investor's total wealth in the TDA and the CSA as given, perhaps as a result of constraints on TDA contributions.

In this setting, it is never optimal to hold tax-exempt bonds in the tax-deferred account, because the taxable bond has a higher before-tax return than the tax-exempt bond. In addition, taxable bonds should not be held in the taxable account if the implicit tax rate on municipal bonds τ_M is smaller than the tax rate on taxable bonds τ_B. In this case, the after-tax returns in the CSA would be higher if the investor held tax-exempt bonds.

To analyze the optimal location of stocks in the one-period model, we suppose that an investor with $\tau_M < \tau_B$ holds tax-exempt bonds in the CSA, taxable bonds in the TDA, and stocks in both the TDA and the CSA. The following argument presents conditions under which it is optimal to increase stock exposure in the TDA and to decrease stock exposure in the CSA.

We increase stock holdings in the TDA by \$1 and reduce holdings of taxable bonds in the TDA by \$1. At the same time, we decrease stock holdings in the CSA by $\$1/(1 - \tau_S)$ and increase the holdings of tax-exempt bonds in the CSA by $\$1/(1 - \tau_S)$. This transaction involves no net investment in total financial assets, and it leaves the investor with the same degree of exposure to risky equity as does the initial portfolio.

Before the portfolio shift, the risky component of the portfolio at the end of the period, which we denote W_S, is

$$W_S = I_{S,\,TDA}[1 + r_S] + I_{S,\,CSA}[1 + (1 - \tau_S)r_S], \tag{1}$$

where initial investments of stocks in the TDA and the CSA are denoted by $I_{S,\,TDA}$ and $I_{S,\,CSA}$, respectively. The riskless component of the initial portfolio, which is the sum of the wealth held in taxable bonds (W_B) and tax-exempt bonds (W_M), is

$$W_B + W_M = I_{B,\,TDA}[1 + r_B] + I_{M,\,CSA}[1 + r_M]. \tag{2}$$

Note that final wealth is $W = W_S + W_B + W_M$.

After the suggested portfolio shift, the values of the risky and risk-free components are

$$W_S' = [I_{S,\,TDA} + 1][1 + r_S] + \left[I_{S,\,CSA} - \frac{1}{1 - \tau_S}\right][1 + (1 - \tau_S)r_S] = W_S - \frac{\tau_S}{1 - \tau_S} \tag{3}$$

and

$$W_B' + W_M' = [I_{B,\,TDA} - 1][1 + r_B] + \left[I_{M,\,CSA} + \frac{1}{1 - \tau_S}\right][1 + r_M] = W_B + W_M + \frac{\tau_S}{1 - \tau_S} + r_B\left(\frac{\tau_S - \tau_M}{1 - \tau_S}\right). \tag{4}$$

The total value of the portfolio after the shift equals

$$W' = W_S' + W_B' + W_M' = W + r_B\left(\frac{\tau_S - \tau_M}{1 - \tau_S}\right). \tag{5}$$

The suggested portfolio shift increases the wealth level at the end of the period if $\tau_S > \tau_M$. The shift does not involve any risk, and investors should take advantage of the profitable arbitrage opportunity offered until they reach borrowing or other constraints.

The foregoing argument shows that stocks have a preferred location in the TDA (Defer Stocks First) if $\tau_S > \tau_M$. Stocks have a preferred location in the CSA if $\tau_S < \tau_M$. If stocks are highly taxed, then they should replace the taxable bonds in the TDA; if stocks are lightly taxed, then they should replace the tax-exempt bonds in the CSA.

Optimal asset location is considerably more complicated in a model with multiple periods, because asset location choices in one period will affect the amount in the tax-deferred account in future periods. In our one-period example, the terminal value of the TDA changes with the portfolio shift:

$$(6) \qquad W'_{TDA} = [I_{S,TDA} + 1][1 + r_S] + [I_{B,TDA} - 1][1 + r_B] = W_{TDA} + r_S - r_B.$$

In a multiperiod setting, having a larger tax-deferred account is beneficial because it allows the investor to shelter a larger proportion of future wealth. Multiperiod asset location choices have to consider the potential long-term effects of current asset location choices on future TDA values.

Simple results like the ones derived above are difficult to obtain analytically in the multiperiod asset location problem. For that reason, we developed numerical results on the wealth that hypothetical investors would have built up after many years of investment if they had pursued various asset location strategies. The remainder of the chapter is devoted to describing those results. While the results depend on the time period that we study, they provide some evidence on how multiperiod investors should analyze their asset location options.

Data on Asset Returns and Investor Tax Rates

Our analysis of the economic effects of different asset location choices relies on data from the 1962–98 period, focusing on hypothetical investors who held equities through actively managed mutual funds rather than through direct equity holdings. We consider the returns on twelve actively managed equity mutual funds that were available to investors for the entire 37-year period; table 10-1 summarizes the total asset values of those funds. The equity funds were sorted according to their total valuation in December 1961 and 1968 as listed by Johnson's Investment Company; the first five funds ("top five funds") were the five largest equity funds at the end of December 1961.[2] Selection and survivorship bias are important because, as Carhart noted, funds with above-average past performance tend to be larger and are less likely to be discontinued.[3] Results using the top five funds are not subject to those biases, whereas results using the other funds might be.

We also collected data for the ten largest equity funds on December 31, 1968, according to Johnson's Investment Company.[4] We augmented that data sample with information on two other funds, the Fidelity Fund and Vanguard Windsor. Our whole sample represents 29.2 percent of the total value of mutual

2. Johnson (1962, 1969).
3. Carhart (1997).
4. Johnson (1969).

Table 10-1. *Equity Mutual Funds in Data Set*[a]

Name	*Assets in millions (year-end 1961)*	*Assets in millions (year-end 1968)*	*Assets in millions (year-end 1998)*
1. MFS Mass. Investors Trust	1,800	2,293	7,142
2. IDS Stock	1,025	2,341	3,257
3. Lord Abbett Affiliated	815	1,805	8,594
4. Fundamental Investors	733	1,391	12,713
5. United Accumulative	601	1,460	1,864
6. MFS Mass. Investors Growth	575	1,264	3,609
7. Fidelity Fund	487	898	10,563
8. Dreyfus	311	2,666	2,591
9. Investment Co. of America	259	1,056	48,498
10. Fidelity Trend	42	1,346	1,198
11. Van Kampen Enterprise	n.a.	953	2,127
12. Vanguard Windsor	n.a.	225	18,188
Summary statistic			
Sum of equity funds	6,647	17,698	120,344
Sum of top five funds in 1961	4,974	9,290	33,570
Total assets of all mutual funds	22,789	52,677	5,525,200
Total number of funds	170	240	7,314

Source: Authors' calculations based on data from Investment Company Institute, Mutual Fund Fact Book, and Johnson's Charts.

a. The top five equity mutual funds correspond to the five largest equity funds at the end of 1961. The results of those five funds should not be subject to survivorship bias. Ten funds (all funds except Fidelity and Vanguard Windsor) were the ten largest equity funds at the end of 1968. The Massachusetts Investors Trust and Massachusetts Investors Growth Funds changed their names to MFS Massachusetts Investors Trust and Growth, respectively. Investors Stock changed to IDS Stock, Affiliated to Lord Abbett Affiliated, the Enterprise Fund to Van Kampen Enterprise, and Windsor to Vanguard Windsor. Investors Mutual and the Wellington Fund were both larger than United Accumulative in 1961; those two funds are not included in our data set because they were balanced funds and held a significant portion of bonds. We excluded the Investors Mutual and the Investors Stock Fund because they were balanced mutual funds in 1968. Moreover, we excluded the ISI Trust Fund because in 1968 it did not issue shares but rather issued ten-year participating agreements.

funds in 1961 and 33.6 percent of the value in 1968. The sample becomes less representative over time, the result of both an increase in the total number of mutual funds and a sharp increase in inflows to equity mutual funds during the 1980s and 1990s. As those inflows were distributed across the funds in existence in those decades, many of which were new entrants that were not available in the 1960s, the share of assets in the "old" equity funds declined. Data from the Investment Company Institute suggest that in 1998 our twelve actively managed mutual funds held only 2.2 percent of the assets invested in mutual funds.[5]

5. Investment Company Institute (2000).

An important issue in interpreting our results is the degree to which the historical performance of the funds we consider is likely to provide guidance on the future performance of today's funds.

The data on the pre- and posttax returns on the equity funds for the years before 1992 are taken from Dickson and Shoven.[6] We updated their data by using Standard & Poor's dividend records (1993–99) and Moody's dividend records (1993–99) for the distributions (dividends and short-, medium-, and long-term capital gains) and by using Interactive Data (part of *Financial Times* Information) for the net asset values of the funds.[7] The annual total return equals the percent change in the value of one mutual fund share purchased at the end of the previous year. The returns are adjusted for splits as necessary. We assume that mutual fund distributions are reinvested on the "ex-dividend date."

To model the taxable and tax-exempt fixed-income investment options available to our hypothetical investor, we use the Vanguard long-term bond fund and the Vanguard long-term municipal bond fund. The annual distributions and net asset values of the two bond funds are taken from Morningstar.[8] Both bond funds paid monthly dividends, and we assume monthly compounding when computing their annual returns. In addition to the twelve actively managed funds that we consider, we also construct a time series of returns that we viewed as corresponding to a passively managed Standard & Poor's (S&P) 500 index fund. When available, we use the returns on the Vanguard 500 index fund for the index fund returns.

Data for the two bond funds and the index fund are available only after the mid-1970s. To indicate the type of returns that investors in such funds would have earned if the funds had been available during the first decade and a half of our sample period, we construct synthetic funds. The returns on the synthetic bond funds are calculated from the year-end yields to maturity of long-term corporate bonds (Moody's AAA-rated bonds) and of long-term tax-exempt bonds (with an average rating of A1) as reported in the *Statistical Release of the Federal Reserve*. The synthetic bond funds are assumed to hold the bonds for one year. The interest income of the funds paid at the end of the year equals the yield to maturity at the issue date minus expenses of 50 basis points. We calculate the capital gain or loss for each bond fund for each year by calculating the capital gain or loss on twenty-year par bonds that were newly issued at the beginning of the year.[9]

6. Dickson and Shoven (1995).

7. Interactive Data (2000), see www.ftinteractivedata.com.

8. Morningstar Principia Plus Database (Chicago: Morningstar Associates, 2000).

9. The capital gain (CG) of the synthetic bond fund between time t and time $t + 1$ was computed as the difference between the price of a nineteen-year bond at time $t + 1$, p_{t+1}^{19} and the price of a twenty-year bond at time t, p_t^{20}. By convention, bonds are issued at par, so $p_t^{20} = 1$. We defined the yield to maturity of a twenty-year bond at time t and a nineteen-year bond at time $t + 1$ as y_t^{20}

Positive capital gains in the synthetic mutual funds are distributed to the shareholders annually and capital losses are carried forward. To ascertain whether the characteristics of the synthetic funds are similar to those of the actual funds, we computed returns on the synthetic funds for the 1979–98 period, when we also have returns on the actual equity index fund and on the two bond funds. The performance of the synthetic fund did not differ much from the performance of the actual fund.[10]

We create a synthetic index fund corresponding to the Vanguard 500 index fund by using the return data on the large stock index of Ibbotson Associates.[11] The synthetic fund distributed dividends net of expenses, which we assumed to equal 25 basis points. The fund's turnover rate of 5 percent results in short- and long-term capital gain distributions, which are distributed if positive and carried forward if negative. The actual index fund and the synthetic index fund yield very similar returns for the period 1979–98.[12]

To evaluate investor performance over the 1962–98 period, we spliced together the returns on our synthetic bond and index funds for the early part of our sample and used the actual returns on those funds in the later part of the sample. We labeled them spliced funds.

We translate the before-tax returns on the various mutual funds in our sample into after-tax returns by using two sets of marginal tax rates for hypothetical high- and medium-tax individuals. We assume that the high-tax individual has taxable income that is ten times the median adjusted gross income, as reported in the Statistics of Income of the Internal Revenue Service, less the standard deduction for a married couple with three exemptions, in each year. The medium-tax individual has taxable income equal to three times median AGI, again less the standard deduction and three exemptions. The tax rates between 1962 and 1992 are taken from Dickson and Shoven;[13] we update them by using

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and y^{19}_{t+1}, respectively. We assumed that yields at all maturities were equal, so that $y^{19}_{t+1} = y^{20}_{t+1}$. In this case,

$$CG_{t+1} = p^{19}_{t+1}/p^{20}_{t} - 1 = (y^{20}_{t}/y^{19}_{t+1})^{*}[(1 - (1 + y^{19}_{t+1})^{-19}] + (1+ y^{19}_{t+1})^{-19} - 1.$$

The interest return at time $t + 1$ of the synthetic bond fund was set equal to the coupon rate at time t, y^{20}_{t}.

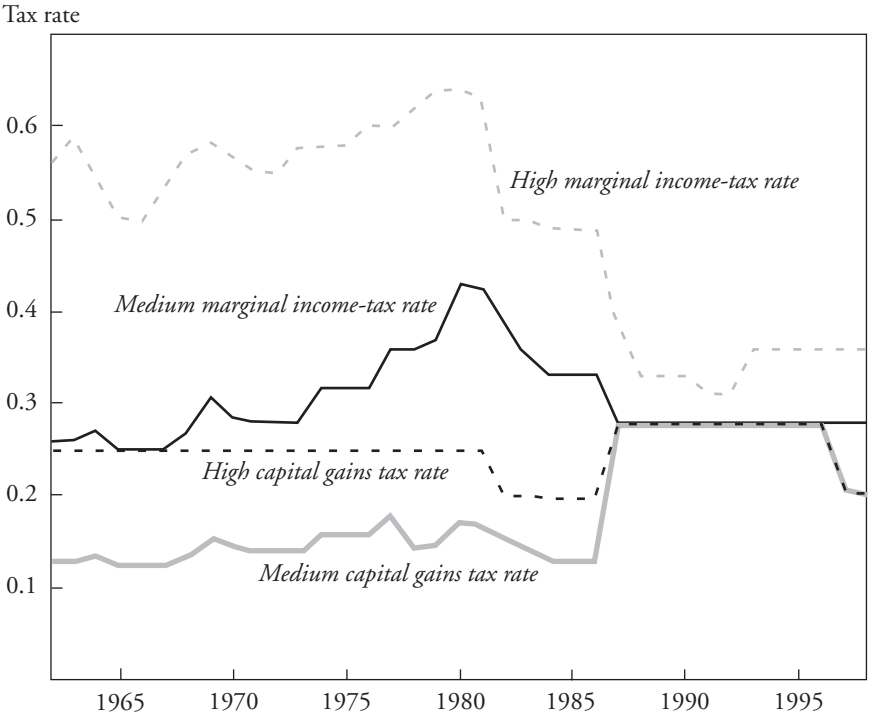
10. The synthetic bond funds had slightly higher mean returns (0.21 percent for the corporate bond fund and 0.43 percent for the municipal bond fund) and considerably higher standard deviations (3.14 percent for the corporate bond fund and 2.53 percent for the municipal bond fund) than the actual bond funds. The correlation coefficients between the returns of the actual and synthetic funds were 0.94 for the corporate bond fund and .99 for the municipal bond fund.

11. Ibbotson Associates (2000).

12. The average return on the synthetic index fund was slightly higher (by 0.10 percent per year) than that on the actual index fund, and the standard deviation of the synthetic index fund return was 0.05 percent higher than that of the actual index fund return. The correlation between the returns on the actual and the synthetic index funds was 0.9997.

13. Dickson and Shoven (1995).

Figure 10-1. *Marginal Tax Rate*[a]



Source: Median AGI was taken from the Statistics of Income of the Internal Revenue Service. The values between 1962 and 1992 were taken from Dickson and Shoven (1995). The tax rates were updated using the instructions to Form 1040 of the IRS (www.irs.gov/forms_pubs/index.html).

a. The time series of the marginal income and long-term capital gains tax rates are depicted for high- and medium-income individuals. Taxable income for a medium-income individual (high-income individual) is computed as three (ten) times the median adjusted gross income (AGI), subtracting the standard deduction for married couples and three exemptions.

tax forms for the years 1993 to 1998. We assume that our medium-tax investor has an income roughly three times the median AGI because stock and bond investors, particularly those with the asset location problem we describe, have much higher incomes than the average household does. We use data on the short- and long-term capital gain distributions of the equity mutual funds in our sample as well as on their dividend distributions to compute after-tax returns. We also consider medium-term capital gain distributions for the applicable years, 1997 and 1998. Figure 10-1 shows the evolution of marginal tax rates for our high-tax and medium-tax investors between 1962 and 1998.

Table 10-2 presents summary statistics on returns for the twelve actively managed equity mutual funds in our sample. They had an average nominal

Table 10-2. *Summary Statistics of Mutual Funds, 1962–98*[a]

Funds	*Average return*	*Standard deviation*	*Dividend distribution*	*ST-CG distribution*	*LT-CG distribution*	*Total ST proportion distribution*	*Total proportion distribution*
A. Actively managed equity funds							
1. Mass. Investors Trust	0.119	0.152	0.034	0.001	0.069	0.292	0.867
2. IDS Stock	0.107	0.149	0.034	0.003	0.052	0.345	0.833
3. LA Affiliated	0.127	0.141	0.045	0.001	0.059	0.362	0.824
4. Fund Investors	0.119	0.156	0.032	0.002	0.044	0.283	0.650
5. United Accumulative	0.110	0.150	0.031	0.017	0.049	0.437	0.885
6. Mass. Investors Growth	0.125	0.195	0.015	0.007	0.072	0.175	0.754
7. Fidelity Fund	0.135	0.152	0.038	0.020	0.043	0.431	0.749
8. Dreyfus	0.113	0.142	0.031	0.014	0.048	0.395	0.823
9. Investment Co. of America	0.140	0.147	0.034	0.000	0.048	0.247	0.586
10. Fidelity Trend	0.117	0.197	0.016	0.007	0.038	0.202	0.523
11. VK Enterprise	0.169	0.288	0.016	0.010	0.048	0.156	0.438
12. Vanguard Windsor	0.139	0.177	0.039	0.007	0.062	0.329	0.779
All equity funds							
Mean	0.127	0.171	0.031	0.007	0.053	0.304	0.726
Standard deviation	0.017	0.042	0.010	0.007	0.011	0.096	0.144
Top five funds							
Mean	0.117	0.150	0.035	0.005	0.055	0.344	0.812
Standard deviation	0.008	0.006	0.006	0.007	0.010	0.062	0.094
B. Spliced funds							
S&P index fund	0.128	0.159	0.036	0.001	0.013	0.288	0.392
Corporate bonds	0.074	0.083	0.081	0.001	0.003	1.095	1.140
Municipal bonds	0.059	0.112	0.061	0.001	0.006	1.054	1.154
C. Consumer price inflation							
CPI	0.047	0.032					

a. This table reports the annual mean nominal returns, the standard deviations of the annual returns, and the distribution characteristics of the funds. Dividend, ST-CG, and LT-CG distributions are the returns distributed to shareholders as dividends, short-term capital gains, and long-term capital gains. The last two columns show the total proportions of the average returns distributed to shareholders as short-term distributions and as short- plus long-term distributions. It is not possible to get long-run data on the S&P 500 index fund, taxable corporate bond funds, and tax-exempt municipal bond funds. Actual data are available for the Vanguard 500 index fund after 1977 and for the Vanguard long-term corporate bond fund and the Vanguard long-term municipal bond fund after 1978. The synthetic funds use market data to replicate the payoffs of those funds before 1977 and 1978 and the data from the actual funds afterward.

return of 12.7 percent over the 1962–98 period and an average standard deviation of the annual returns of 17.1 percent. Ibbotson Associates reports that the rate of consumer price inflation had a mean of 4.7 percent and a standard deviation of 3.2 percent for the same period.[14]

The mean nominal returns and the standard deviations of the funds differ considerably. The Van Kampen Enterprise Fund had the highest average nominal return (16.9 percent) and the highest standard deviation (28.8 percent). The IDS Stock Fund had the lowest average return (10.7 percent), and the Affiliated Fund had the lowest standard deviation (14.1 percent). The top five funds had a considerably lower mean return than the remaining seven funds (11.7 percent versus 13.4 percent), possibly because of survivorship bias.

Table 10-2 gives particular attention to the division among dividends, realized capital gains, and unrealized capital gains in the composition of returns received by investors. On average the twelve funds distributed 72.6 percent of their total return annually, either as dividends or capital gains, and 30.4 percent of the total average returns were either dividends or short-term capital gains.[15] Capital gains that were not distributed were deferred until the investor sold the mutual fund shares. The most successful fund, Van Kampen Enterprise Fund, distributed only 43.8 percent of its total returns, whereas the relatively poorly performing United Accumulative Fund distributed 88.5 percent of its total return. The top five funds tended to impose somewhat higher tax burdens on their investors than the other funds since they distributed a larger portion of their total returns and since a larger portion of their distributions did not qualify as long-term capital gains.

The passively managed spliced index fund had an average nominal return of 12.8 percent and a standard deviation of 15.9 percent. The average return on the index fund was similar to that for our whole sample of equity funds, and it was considerably higher than the average return on the bias-free top five funds. The passively managed index fund exhibited a smaller difference between pretax and posttax returns than did the actively managed equity funds. On average only 39.2 percent of its total nominal return was distributed to shareholders, and only a small portion of those distributions resulted from the distribution of realized capital gains.

The spliced corporate bond fund had a mean nominal return of 7.4 percent and a standard deviation of 8.3 percent, while the spliced tax-exempt municipal bond fund had a lower mean nominal return (5.9 percent) and a higher standard deviation (11.2 percent). Both bond funds distributed most of their total returns as interest income.

14. Ibbotson Associates (2000).

15. The data sources did not always distinguish between short- and long-term capital gains. We assumed that capital gains were long term if the sources did not indicate the term. That resulted in an overstatement of the actual tax efficiency of the mutual funds.

Asset Location and Investor Returns: Historical Evidence

Our data make it possible for us to compute asset location results for the period 1962–98 for the twelve actively managed equity mutual funds as well as the three spliced funds. The investor is assumed to have made identical contributions (in constant dollars) each year to a tax-deferred pension account and to a conventional taxable savings account. We normalize the total annual contributions to $1.00 in 1998 purchasing power. The actual 1998 contributions were 50 cents to each account, whereas the earlier contributions were less in nominal dollars. The total real investment over the 37-year period was $37 at 1998 prices.

We assume that half of each annual investment was placed in the TDA and half in the CSA and that the investor wants half of his or her total portfolio in stocks and half in bonds.[16] We assume that half of the initial 1962 investments were made in stocks and half in bonds; thereafter, the investor adjusted the portfolio annually to maintain the fifty-fifty balance. Rebalancing is attempted first by adjusting the composition of new investments, and if necessary, assets were sold and bought in order to maintain the desired proportions of stocks and bonds. At the end of the year, the investor is taxed on the taxable mutual fund distributions and the realized capital gains from selling fund shares in the taxable account. Realized losses are carried forward and subtracted from future capital gains. At the end of the sample period, the investor liquidated all assets and pays the necessary capital gains taxes as well as ordinary income taxes on withdrawals from the TDA. The dollar figures shown in our tables thus represent retirement accumulations after the payment of all taxes.

We evaluate two possible asset location rules. The first, Defer Stocks First, gives the equity mutual fund priority for placement in the TDA; the corporate bond fund is held in the TDA only if there were room after all of the investor's desired equity is in the TDA. Municipal bonds have a preferred location in the CSA. The second rule, Defer Bonds First, gives the corporate bond fund priority for placement in the TDA, and the equity mutual fund priority for placement in the CSA. If it were necessary to hold bonds in the CSA to maintain the desired fifty-fifty asset allocation, then the investor would hold the municipal bond fund there.

16. When we computed the stock proportions we did not adjust the value of assets held in the two different accounts to reflect deferred taxes. That raises at least two issues. First, the investor owns only $(1-t)$ of the assets invested in the tax-deferred account, because the government taxes withdrawals from a tax-deferred account at the rate t. Second, the realized returns of assets in the CSA are taxed annually, and that reduces their accumulation. Whether one dollar invested in a TDA is more valuable than one dollar invested in a CSA depends on the investment horizon. One dollar invested in a CSA is more valuable at a sufficiently short investment horizon, and one dollar invested in a TDA is more valuable at a sufficiently long horizon.

Table 10-3. *Asset Location Results*[a]

	High-tax individual			*Medium-tax individual*		
Type of fund	*Wealth at retirement (Defer Stocks First)*	*Wealth at retirement (Defer Bonds First)*	*Relative wealth*	*Wealth at retirement (Defer Stocks First)*	*Wealth at retirement (Defer Bonds First)*	*Relative wealth*
A. Actively managed mutual funds						
1. Mass. Investors Trust	90.49	84.59	1.070	98.21	93.30	1.053
2. IDS Stock	79.91	74.94	1.066	86.30	83.15	1.038
3. LA Affiliated	91.75	81.20	1.130	99.61	91.93	1.084
4. Fund Investors	89.02	88.26	1.009	96.57	96.84	0.997
5. United Accumulative	81.11	73.07	1.110	87.68	82.91	1.058
6. Mass. Investors Growth	92.70	89.60	1.035	100.72	98.02	1.028
7. Fidelity Fund	100.68	88.31	1.140	109.66	100.86	1.087
8. Dreyfus	74.18	64.56	1.149	79.83	73.73	1.083
9. Investment Co. of America	101.03	96.08	1.052	110.05	106.39	1.034
10. Fidelity Trend	71.21	69.40	1.026	76.49	76.05	1.006
11. VK Enterprise	109.23	98.85	1.105	119.31	108.86	1.096
12. Vanguard Windsor	102.20	87.21	1.172	111.37	100.15	1.112
All funds						
Mean	90.29	83.01	1.089	97.98	92.68	1.056
Standard deviation	11.87	10.59	0.053	13.36	11.45	0.037
Top five funds						
Mean	86.46	80.41	1.077	93.67	89.62	1.046
Standard deviation	5.53	6.39	0.047	6.22	6.28	0.032
B. Index fund						
S&P 500	96.28	97.91	0.983	104.72	106.91	0.980

a. The real wealth levels at retirement are reported for an individual making annual real contributions of $0.50 to both a tax-deferred account (TDA) and a conventional taxable savings account (CSA) during a period of 37 years, from 1962 to 1998. The investor annually adjusts the portfolio to maintain a 50 percent proportion of stock funds; the remaining 50 percent is allocated to either taxable corporate bonds or tax-exempt municipal bonds. The Defer Stocks First strategy gives preference to stocks in the TDA and to municipal bonds in the CSA, and the Defer Bonds First strategy gives preference to corporate bonds in the TDA and to stocks in the CSA.

Table 10-3 shows our basic asset location results. Defer Stocks First yielded higher terminal wealth values than Defer Bonds First for all twelve of the actively managed equity mutual funds for the high-income, high-tax investor and for eleven of the twelve funds for the medium-income, medium-tax investor. The additional wealth accumulated by following the Defer Stocks First rule could be quite large. For the twelve actively managed funds as a whole the

average gain from deferring stocks first was 8.9 percent for high-tax retirement accumulators. For the five largest funds in 1961, the gain averaged 7.7 percent. For an investor who contributed $10,000 (1998 dollars) per year to both the CSA and the TDA in each year between 1962 and 1998, the 7.7 percent differential translated to additional wealth of more than $140,000 in 1998.[17]

The equity mutual fund that gained the most from deferring stocks first was the Vanguard Windsor fund. Its before-tax performance was better than average over the 1962–98 period, while it imposed a higher-than-average tax burden on its investors. With Vanguard Windsor, the Defer Stocks First rule resulted in more than 17 percent more retirement wealth than Defer Bonds First. The actively managed fund for which the advantage of deferring stocks first was the smallest was the Fundamental Investors Fund. Its before-tax performance was worse than average, and its investor tax burden was better than average. For high-income investors using Fundamental Investors in a fifty-fifty stock-bond asset allocation plan, Defer Stocks First conferred an advantage of less than 1 percent. For the medium-income investor using Fundamental Investors, Defer Bonds First worked better than Defer Stocks First, although the difference was extremely small. For the eleven other funds, Defer Stocks First yielded between 1 and 17 percent more after-tax wealth than Defer Bonds First.

Interestingly, considering the S&P 500 index fund, the Defer Bonds First rule yielded the highest terminal wealth. The S&P index fund had slightly better before-tax returns than the average actively managed fund, almost all due to its low expenses, and it imposed much lower tax burdens on its investors. In that case the advantage of deferring bonds instead of stocks was considerable. A high-tax investor holding shares in an S&P 500 fund in a TDA and municipal bonds in a CSA would have ended up with 1.7 percent less retirement wealth than a similar investor who put corporate bonds in a TDA and held the index fund in a CSA. That result is important, because it suggests that the rise of relatively tax-efficient mutual funds in the 1990s may affect the applicability of our findings to investors who hold equities through those funds.

One reason that the Defer Stocks First rule yielded greater end-of-period wealth than Defer Bonds First for most actively managed equity funds during our sample period was that equities have experienced higher rates of return than bonds and thus would have generated higher tax bills in a taxable environment. That is related to the well-documented equity premium puzzle described by Mehra and Prescott.[18] One could ask whether Defer Stocks First still would

17. While we modeled people who chose a particular equity mutual fund and stuck with it, many investors periodically switch funds. Switching generates taxable capital gains in a CSA, raising the wealth accumulated from applying the Defer Stocks First rule relative to that accumulated from applying Defer Bonds First.

18. Mehra and Prescott (1985).

Table 10-4. *Sensitivity Analysis with Lower Equity Premiums*[a]

	Reduction in equity premium (in basis points)					
Type of fund	*0*	*100*	*200*	*300*	*400*	*500*
A. Actively managed mutual funds						
1. Mass. Investors Trust	1.070	1.048	1.031	1.018	1.008	1.000
2. IDS Stock	1.066	1.048	1.034	1.025	1.017	1.010
3. LA Affiliated	1.130	1.102	1.078	1.059	1.043	1.030
4. Fund Investors	1.009	0.994	0.984	0.978	0.975	0.974
5. United Accumulative	1.110	1.089	1.074	1.063	1.055	1.050
6. Mass. Investors Growth	1.035	1.017	1.004	0.994	0.989	0.984
7. Fidelity Fund	1.140	1.113	1.091	1.072	1.056	1.045
8. Dreyfus	1.149	1.127	1.108	1.093	1.081	1.072
9. Investment Co. of America	1.052	1.033	1.017	1.002	0.992	0.985
10. Fidelity Trend	1.026	1.019	1.014	1.013	1.016	1.020
11. VK Enterprise	1.105	1.091	1.076	1.065	1.055	1.045
12. Vanguard Windsor	1.172	1.147	1.125	1.106	1.089	1.074
All funds						
Mean	1.089	1.069	1.053	1.041	1.031	1.024
Standard deviation	0.053	0.049	0.045	0.041	0.037	0.034
Top five funds						
Mean	1.077	1.056	1.040	1.029	1.020	1.013
Standard deviation	0.047	0.043	0.038	0.034	0.031	0.029
B. Index fund						
S&P 500	0.983	0.966	0.952	0.946	0.945	0.946

a. This table reports the relative wealth levels of the two location strategies for a high-tax individual if the return of the equity funds is decreased. The distributions of the equity funds are adjusted proportionally. The first column corresponds exactly to the third column in table 10-3.

generate higher end-of-period wealth if the average return advantage of equities were lower. Table 10-4 answers that question for our high-tax, high-income investor. Each successive column presents results based on a 100-basis-point reduction in realized fund returns compared with those in the previous column. All fund distributions (dividends and capital gains) are reduced proportionally. Each additional 100-basis-point reduction lowers the average advantage of first deferring stocks, but by decreasing amounts. Even an unrealistically high reduction of 500 basis points (that is, one that eliminates the premium of equity funds over corporate bonds) would leave Defer Stocks First generating higher end-of-period wealth than Defer Bonds First for nine of the twelve actively managed funds. The results in table 10-4 suggest that the difference in wealth accumulated by applying the two location rules would be attenuated if the average return on stocks were lower than that in the 37-year period that we studied.

Table 10-5. *Asset Location without Municipal Bonds*[a]

	High-tax individual			*Medium-tax individual*		
Type of fund	*Wealth at retirement (Defer Stocks First)*	*Wealth at retirement (Defer Bonds First)*	*Relative wealth*	*Wealth at retirement (Defer Stocks First)*	*Wealth at retirement (Defer Bonds First)*	*Relative wealth*
A. Actively managed mutual funds						
1. Mass. Investors Trust	79.04	84.54	0.935	92.64	93.49	0.991
2. IDS Stock	69.72	74.89	0.931	81.46	83.25	0.979
3. LA Affiliated	80.99	81.21	0.997	94.85	91.75	1.034
4. Fund Investors	78.14	88.17	0.886	91.62	96.68	0.948
5. United Accumulative	70.99	73.07	0.972	83.06	82.87	1.002
6. Mass. Investors Growth	80.87	89.54	0.903	94.80	98.20	0.965
7. Fidelity Fund	88.88	88.26	1.007	104.28	100.88	1.034
8. Dreyfus	64.85	64.47	1.006	75.53	73.71	1.025
9. Investment Co. of America	89.62	94.68	0.947	105.07	105.58	0.995
10. Fidelity Trend	62.05	69.25	0.896	72.15	76.21	0.947
11. VK Enterprise	96.18	96.40	0.998	112.55	108.01	1.042
12. Vanguard Windsor	91.29	85.37	1.069	107.05	98.63	1.085
All funds						
Mean	79.38	82.49	0.962	92.92	92.44	1.004
Standard deviation	10.88	10.08	0.055	12.91	11.15	0.042
Top five funds						
Mean	75.77	80.37	0.944	88.73	89.61	0.991
Standard deviation	5.08	6.37	0.042	6.04	6.23	0.032
B. Index fund						
S&P 500	84.48	97.77	0.864	99.15	106.95	0.927

a. The results in this table differ from those of table 10-3 in that individuals were not allowed to invest in municipal bonds. Corporate bonds were held in both the TDA and the CSA.

The results in table 10-4 derive from both the fact that capital gain distributions on actively managed equity funds raise their effective tax burden and the fact that the implicit tax rate on tax-exempt bonds was below the statutory marginal tax rate throughout our sample. Table 10-5 helps to indicate the relative importance of these two factors. It presents results in which investors did not take advantage of their option to hold municipal bonds; instead, they invested in a single equity mutual fund and a corporate bond fund. The only location decision to be made was whether to give the equity fund preference in the TDA and the corporate bond preference in the CSA, or vice versa. Without the use of municipal bonds, the Defer Stocks First rule generated higher end-of-period

wealth for only three of the twelve actively managed mutual funds for the high-income investor. For the other equity mutual funds, Defer Bonds First produced more retirement wealth, often quite a bit more. The average gain of deferring bonds first for the twelve actively managed funds was 3.8 percent. Defer Stocks First yielded higher relative wealth values for the medium-income, medium-tax investor for six of the twelve actively managed equity funds. In fact, even without allowing municipal bonds, average retirement wealth from applying the Defer Stocks First rule was slightly greater than that from applying Defer Bonds First for the medium-tax investor.

Our interpretation of tables 10-3 and 10-5 is that the average actively managed mutual fund produced an effective tax rate for its high-income taxable holders that was higher than the implicit tax rate on municipal bonds. Hence most of the actively managed funds would have gained more from being in a TDA than would corporate bonds, given the availability of tax-exempt bonds for investments in a CSA. The only equity mutual fund that would have generated an effective tax rate significantly lower than the implicit tax rate on municipal bonds was the passively managed index fund. The presence of municipal bonds was less important for the medium-income investors, because the effective tax rate on the equity funds was lower (due to lower tax rates on ordinary income and capital gains), but the implicit tax rate on municipal bonds was the same. Tables 10-3 and 10-5 underscore the fact that the conventional wisdom, which holds that it is best to give preference to corporate bonds for placement in a TDA, is based on analysis that does not consider the availability of municipal bonds.

One caution should be noted in comparing taxable and tax-exempt bond yields and calculating implicit tax rates from those yields. Investors in taxable and tax-exempt bonds may face somewhat different risks, and the differential between the yields on those bonds may reflect both tax considerations and the pricing of those risks. One particularly important risk, noted in Poterba (1989), is that of tax reform. Tax-exempt bonds could experience substantial valuation changes if the current income-tax treatment of taxable and tax-exempt bonds changes. Quantifying the price that investors demand for bearing that risk and modifying the implicit tax rate accordingly is very difficult.

The results in tables 10-3 and 10-5 assume that the then-current tax laws applied to returns generated in each year during our sample period. Since marginal tax rates on dividend and interest income are lower now than at some points in our sample, that assumption may limit the prospective applicability of our findings. To address that concern, in table 10-6 we present findings in which we apply the 1998 tax law to the 1962–98 returns generated by the CSA assets. Table 10-6 shows that the after-tax wealth realized from applying the Defer Bonds First rule would have been much higher compared with that from Defer Stocks First, if the 1998 tax law had been in force throughout the

Table 10-6. *Asset Location Results with Taxes from 1998*[a]

	High-tax individual			*Medium-tax individual*		
Type of fund	*Wealth at retirement (Defer Stocks First)*	*Wealth at retirement (Defer Bonds First)*	*Relative wealth*	*Wealth at retirement (Defer Stocks First)*	*Wealth at retirement (Defer Bonds First)*	*Relative wealth*
A. Actively managed mutual funds						
1. Mass. Investors Trust	90.78	90.24	1.006	98.45	96.25	1.023
2. IDS Stock	80.18	79.20	1.012	86.52	85.29	1.014
3. LA Affiliated	92.01	87.60	1.050	99.84	94.61	1.055
4. Fund Investors	89.32	93.18	0.959	96.80	99.33	0.975
5. United Accumulative	81.41	76.66	1.062	87.89	84.24	1.043
6. Mass. Investors Growth	93.02	94.49	0.984	100.97	100.02	1.009
7. Fidelity Fund	100.96	93.81	1.076	109.91	102.68	1.070
8. Dreyfus	74.41	68.74	1.083	80.03	75.48	1.060
9. Investment Co. of America	101.29	101.63	0.997	110.28	108.23	1.019
10. Fidelity Trend	71.45	72.40	0.987	76.68	77.69	0.987
11. VK Enterprise	109.52	104.93	1.044	119.53	111.31	1.074
12. Vanguard Windsor	102.46	94.73	1.082	111.58	102.82	1.085
All funds						
Mean	90.57	88.13	1.028	98.21	94.83	1.035
Standard deviation	11.88	11.46	0.043	13.37	11.67	0.036
Top five funds						
Mean	86.74	85.37	1.018	93.90	91.94	1.022
Standard deviation	5.53	7.13	0.041	6.22	6.78	0.031
B. Index fund						
S&P 500	96.57	101.86	0.948	104.97	108.43	0.968

a. The results in this table differ from those in table 10-3 in that tax rates from 1998 were used instead of the historical taxes from 1962 to 1998.

1962–98 period, particularly for high-income investors. Nonetheless, Defer Stocks First still would have yielded higher end-of-period wealth for eight of the twelve actively managed mutual funds. The counterfactual tax assumption of table 10-6 affects the results less for the medium-income investor, with Defer Stocks First still generating more retirement wealth for ten of the twelve actively managed mutual funds.

Table 10-6 does not describe what actually would have happened if the 1998 tax code had prevailed over the entire 37-year period. We did not adjust the implicit tax rate on municipal bonds even though it presumably would have

dropped in the presence of lower marginal tax rates on high-income households. Similarly, we did not adjust the before-tax rates of return of any of the assets, even though a significant tax change presumably would have substantial general equilibrium effects. It also is possible that with different tax rates, the proportions of dividends and capital gains in equity returns would have differed from historical values.

Asset Location and Investor Returns: Simulation Evidence

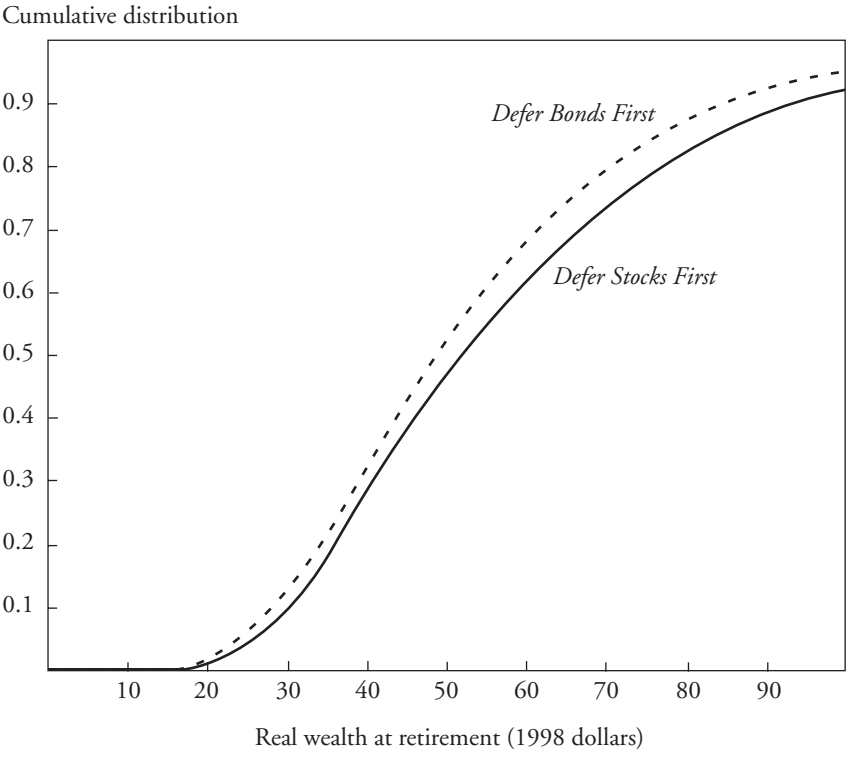
The foregoing asset location results show the performance of different strategies using historical data over the period 1962–98, a period that in many respects was unrepresentative: equity returns were relatively high; the rate of inflation was high and very volatile; and marginal tax rates changed considerably. To determine whether our results are robust, we ran some bootstrap simulations. Each simulation proceeded in two steps: first we selected one mutual fund from our sample at random, and then we drew a random sequence of years with replacement. For each year selected, we drew the selected fund's return, the returns of two bond funds, the inflation rate, and the tax rate. We computed the level of wealth of investors making constant real annual contributions to a CSA and TDA for 37 years, as described above. All the simulations were repeated 10,000 times.

Our bootstrap returns address only the issue of the sequencing of returns during the 1962–98 period. They do not address what is likely to be a more important source of uncertainty, namely the possibility that future returns will be generated from a different return distribution than the one observed over the last four decades.

Figure 10-2 shows the probability distributions of real wealth levels at retirement of the two asset location strategies for a high-tax individual choosing from the set of the five largest mutual funds in December 1961. The Defer Stocks First rule outperforms Defer Bonds First at all probability levels except in the four lowest of the 10,000 simulations. That means that the probability of reaching a particular wealth level or higher was almost always greater with Defer Stocks First than with Defer Bonds First.

Table 10-7 shows numerical values corresponding to several points in the probability distribution shown in figure 10-2. The real wealth level of Defer Stocks First exceeded that of Defer Bonds First by 3.7 percent at the 1st percentile, by 6.1 percent at the median, and by 16.4 percent at the 99th percentile. The portfolio selection of this investor is quite risky. There is a more than 20 percent probability that the real wealth level accumulated at retirement will not exceed the 37 real dollars invested and there is a more than 20 percent probability that retirement wealth under Defer Stocks First will exceed twice the total real investments (74 real dollars).

Figure 10-2. *Wealth Distribution of the Two Asset Location Strategies with Bootstrap Simulations, Top Five Funds*[a]



a. The cumulative distribution of real wealth at retirement resulting from saving $1.00 per year for thirty-seven years is depicted for the two asset location strategies. The investor chooses randomly among the five largest mutual funds in each of the 10,000 bootstrap simulations.

The median wealth level at retirement achieved by applying the Defer Stocks First rule was $51.81, considerably lower than the $86.46 from table 10-3 that was computed using the actual history instead of simulated returns. A realization of $86.46 would be an outcome at the 87th percentile in our bootstrap simulations. The main reason for that discrepancy is the ordering of the returns between 1962 and 1998. The ordering of the identical returns had a substantial effect on the wealth level at retirement for investors making contributions over many years to their savings account. The arithmetic average of the real returns of the S&P 500 index fund was 2.2 percent during 1962–79 and 13.9 percent during 1980–98. The computations that used actual historical returns had the low returns in the first half of our investment horizon (when the accumulated

Table 10-7. *Wealth Distribution with Bootstrap Simulations*[a]

	Cumulative distribution						
Type of fund	*0.001*	*0.010*	*0.100*	*0.500*	*0.900*	*0.990*	*0.999*
A. All actively managed funds							
Wealth (Defer Stocks First)	14.80	20.31	31.16	55.87	107.53	195.71	343.71
Wealth (Defer Bonds First)	13.81	19.65	30.13	53.65	101.00	186.57	312.93
Relative wealth	0.686	0.780	0.885	1.050	1.228	1.397	1.577
B. Top five actively managed funds							
Wealth (Defer Stocks First)	14.55	19.46	29.94	51.81	93.73	155.08	211.14
Wealth (Defer Bonds First)	13.81	18.76	28.55	48.82	84.98	133.24	188.42
Relative wealth	0.762	0.820	0.920	1.069	1.24	1.411	1.579
C. Index fund							
Wealth (Defer Stocks First)	14.98	20.24	32.01	57.18	106.92	182.06	264.07
Wealth (Defer Bonds First)	14.82	19.95	32.44	58.05	105.26	173.70	259.52
Relative wealth	0.706	0.762	0.854	0.995	1.152	1.298	1.460

a. The probability distributions of the real wealth levels of a high-income individual are shown for the two location strategies. Individuals randomly chose one equity fund and contributed as described in table 10-3. The returns of the assets were bootstrapped 10,000 times.

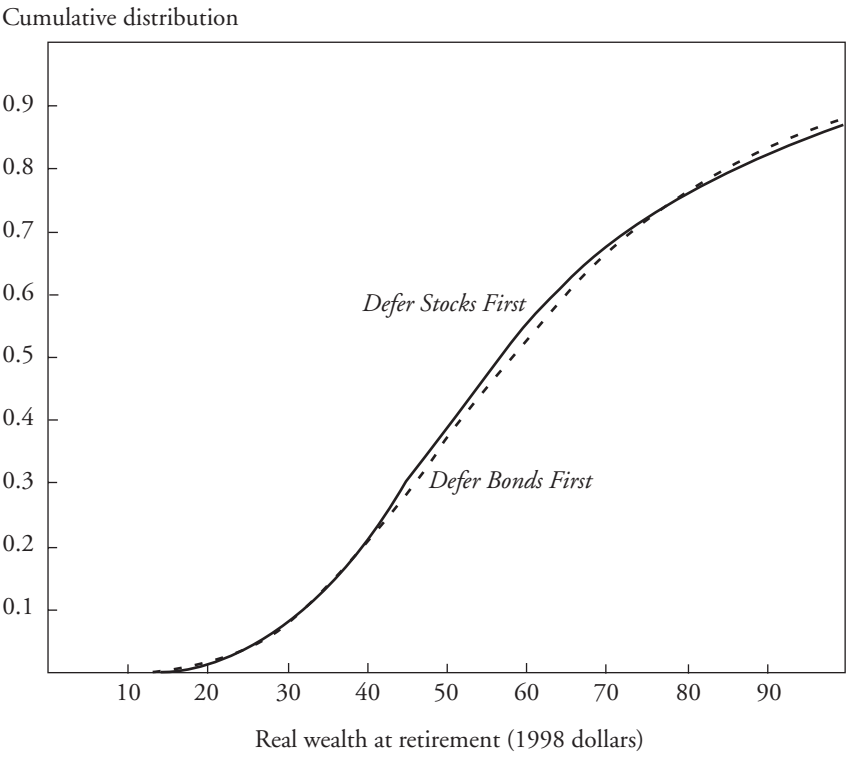
contributions were relatively small) and the high returns in the second half (when the accumulated contributions were large). Those back-loaded returns generated higher wealth levels at retirement compared with the distribution of returns that occurred in the bootstrap simulations.[19]

If we let history run backward (that is, the 1998 returns occur first, the 1997 returns second, and the 1962 returns last), then we accumulate a real wealth level of $32.70 under the Defer Stocks First rule, which corresponds to the 15th percentile of the bootstrap distribution. That is because the low returns occur when the investor has a large accumulated asset balance.

Table 10-7 also summarizes the distribution for investors who randomly chose funds from the whole set of twelve actively managed equity funds and who chose the spliced index fund. Defer Stocks First outperformed Defer Bonds First at all indicated points of the cumulative distribution for the actively man-

19. The ordering of the returns r_t was irrelevant if investors made only a single contribution to an account. In that case the final wealth level was simply the product of the return relatives $W_T = \prod_{t=0}^{T}(1 + r_t)$. Ordering had a significant effect on accumulated wealth levels for investors making multiple contributions to an account. We can think of the portfolio with multiple contributions as the sum of a sequence of single-contribution portfolios with decreasing maturities $\sum_{t=0}^{T}[W_t] = \sum_{t=0}^{T}[\prod_{i=t}^{T}(1 + r_i)]$. The returns during the last years affected most of the single-contribution portfolios, whereas the returns during the first years affected only a few of them.

Figure 10-3. *Wealth Distribution with Bootstrap Simulations, Index Fund*[a]



a. The cumulative distribution of real wealth at retirement resulting from saving $1.00 per year for thirty-seven years is depicted for the two asset location strategies. The investor holds a spliced Standard & Poor's 500 index fund.

aged equity funds. The probability distribution function for the whole sample of twelve funds usually lies to the right of the one for the top five funds, because the five largest funds did not perform as well as the seven other funds. Figure 10-3 shows that the distributions of the two location strategies are quite close if an investor held a passively managed index fund, underscoring our earlier point that asset location is less important in that case than in the case of actively managed funds.

To facilitate comparison of the different cases, we summarize the whole probability distribution of the 10,000 simulations by computing the certainty equivalent wealth level of an individual with a constant relative risk aversion (CRRA) utility function. The expected utility of real wealth EU = E[U(W)] of the investor is defined as

$$EU = E[U(W)] = \frac{1}{n} \sum_{i} \frac{W_i^{1-\alpha}}{1-\alpha} \cdot \tag{7}$$

Simulations are indexed by i, the real wealth level is W_i, and we denote the risk aversion coefficient by α and the total number of bootstrap simulations by n. The certainty equivalent wealth level is the certain wealth level for which an individual is indifferent between that wealth and the distribution of wealth outcomes from the random 10,000 simulations. We assume that income from assets accumulated in the CSA and the TDA is the only source of income during retirement. The certainty equivalent is given by

$$CE(EU) = U^{-1}(EU) = [(1-\alpha)EU]^{1/(1-\alpha)}. \tag{8}$$

Table 10-8 summarizes the certainty equivalents for five levels of risk aversion. The values with a risk aversion of $\alpha = 0$ equal the expected wealth levels. Most economists think that coefficients of relative risk aversion between 1 (log-utility) and 5 are plausible. The average real wealth level at retirement for investments in the five largest mutual funds applying the Defer Stocks First rule equaled $58.09; investing in all twelve mutual funds and in the index fund resulted in considerably higher average wealth levels. All the certainty equivalents for the actively managed equity funds were larger if stocks instead of bonds were deferred first. Defer Stocks First resulted in a 5.2 percent higher certainty equivalent for an individual with a risk aversion of 3 investing in the top five funds; however, Defer Bonds First yielded higher certainty equivalents for intermediate levels of risk aversion if investors held the index fund, which has a higher certainty equivalent than the actively managed funds. Those results confirm the deterministic results above.

Figure 10-4 shows the relationship between the real wealth levels of the two location strategies using exactly the same simulation results as in figure 10-2. The 45-degree line represents the cases in which the wealth levels were identical for the two location strategies. There are 7,116 points (of 10,000) below the 45-degree line and 2,884 points above. Thus, Defer Stocks First outperformed Defer Bonds First 71.2 percent of the time. The distribution of the relative wealth levels of the two strategies is summarized in the third row of table 10-7. Defer Stocks First outperformed Defer Bonds First in 64.0 percent of the simulations if investors chose among all twelve funds and in 48.5 percent of the cases with the index fund.

The previous results analyze the optimal asset location choice for an asset allocation of 50 percent stocks and 50 percent bonds, a rule-of-thumb allocation that is not necessarily optimal. Moreover, the optimal stock proportion for an investor might depend on his or her location strategy, since the two strategies

Table 10-8. *Certainty Equivalents of Bootstrap Results*[a]

	Coefficient of relative risk aversion				
Type of fund	*0*	*1*	*3*	*5*	*10*
A. All actively managed funds					
CE (Defer Stocks First)	64.86	57.20	45.96	38.02	26.11
CE (Defer Bonds First)	61.64	54.67	44.23	36.67	25.46
Relative CE	1.052	1.046	1.039	1.037	1.026
B. Top five actively managed funds					
CE (Defer Stocks First)	58.09	52.46	43.30	36.31	24.90
CE (Defer Bonds First)	53.78	49.11	41.16	34.82	24.73
Relative CE	1.08	1.068	1.052	1.043	1.007
C. Index fund					
CE (Defer Stocks First)	64.89	57.93	46.80	38.57	26.63
CE (Defer Bonds First)	64.86	58.27	47.23	38.66	26.44
Relative CE	1.001	0.994	0.991	0.998	1.007

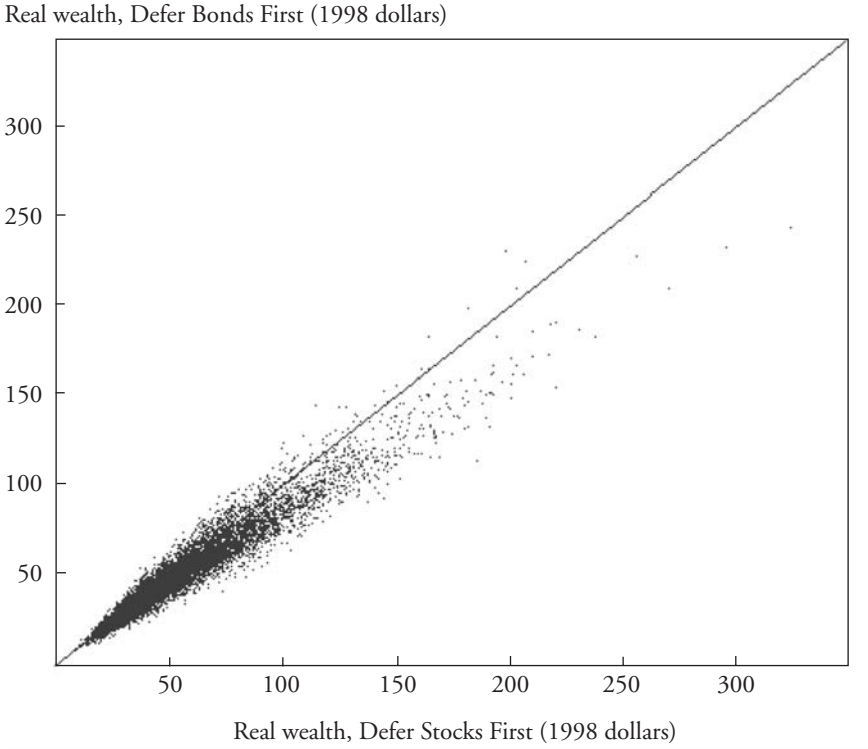
a. This table records the certainty equivalents (CE) of the bootstrap simulations of the two location strategies for a high-tax individual with a constant relative risk aversion (CRRA) utility function. The wealth resulting from the investment in the two accounts is the only source of income at retirement. The returns were bootstrapped 10,000 times.

have different effective stock exposures. To provide some illustrative calculations of the expected utilities associated with different stock-bond allocations, we performed bootstrap simulations for eleven different stock proportions (0.0, 0.1, . . . , 1.0) and computed the corresponding certainty equivalents of the two location choices. Figure 10-5 plots the results for high-tax individuals with risk aversions of 3 and 5 who invested in the five largest actively managed mutual funds. Note that asset location is irrelevant in the cases in which the investor holds either only bonds or only stocks, since the same assets are held in both locations.

We found that the certainty equivalent of the Defer Stocks First rule usually was higher than that of Defer Bonds First. At a risk aversion of 3, the certainty equivalent was maximized at a stock proportion of between 80 and 100 percent with Defer Stocks First and of 100 percent with Defer Bonds First. At stock proportions that high, the effect of optimal asset location is smaller than when the stock proportion is 50 percent.

Asset location was more important if investors had a risk aversion of 5 than if they were more risk tolerant. Asset location increased the certainty equivalent by 4.9 percent (the maximal certainty equivalent wealth level was 37.21 with Defer Stocks First and 35.46 with Defer Bonds First). A 100 percent stock portfolio

Figure 10-4. *Relationship between the Wealth Levels of the Two Location Strategies, Top Five Funds*[a]



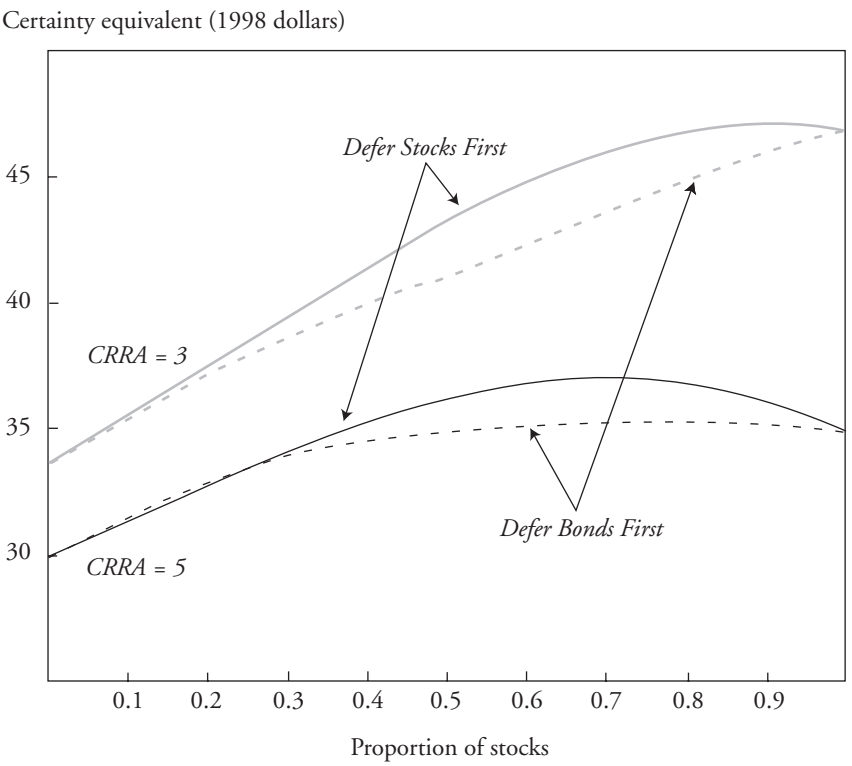
a. The relationship between real wealth levels at retirement between the two asset location strategies is depicted. The investor chooses randomly among the five largest mutual funds in each of the 10,000 bootstrap simulations. The simulation results are identical to those in figure 10-2.

had a higher certainty equivalent than a 100 percent bond portfolio for both levels of risk aversion.

Asset Location with Inflation-Protected Bonds

The corporate and municipal bond funds in the previous asset allocation and asset location analysis are exposed to at least three risks that can be reduced with recently introduced government securities. These risks are the default risk of individual issues; inflation risk; and reinvestment risk. Reinvestment risk results from the fact that the bond or bond fund investor cannot be sure of the terms on which future interest payments can be reinvested. Inflation risk results from

Figure 10-5. *Certainty Equivalents of Different Asset Allocations*[a]



a. The certainty equivalent wealth levels are computed for different asset allocations (stock proportions range between 0 and 100 percent) and different asset locations (either the stocks or the taxable bonds are deferred first). The certainty equivalents are shown for coefficients of relative risk aversion (CRRA) of 3 and 5.

the fact that corporate and municipal bonds are nominal contracts. While investing in high-grade securities can control default risk, corporate and municipal borrowers usually are considered riskier than the U.S. government.

Since 1997, the U.S. government has issued inflation-indexed bonds, which essentially eliminate all of the risks just described. There are two forms of inflation-indexed bonds. The first are Treasury inflation-protected securities (TIPS), which are U.S. government bonds with fixed maturities (so far, five-, ten-, and thirty-year bonds have been issued), real interest payments, and a principal amount adjusted to reflect inflation in the consumer price index (CPI). Both the interest payment and the adjustment in the principal amount are fully taxable if TIPS are held in a conventional savings account, but those considerations

are not relevant in a TDA. TIPS essentially eliminate the default and inflation risks of corporate and municipal bonds, but they still are subject to reinvestment risk. Investors also may bear some risk associated with potential redefinition of the consumer price index. The real return on TIPS in 2000 is near 4 percent.

The other U.S. government inflation-indexed security is the Series I savings bond, which is issued in denominations of from $50 to $10,000. Like all savings bonds, I bonds are zero coupon instruments with taxation deferred until redemption, and, as with all federal notes, bills, and bonds, the interest on I bonds is exempt from state and local income tax. I bonds are nontransferable and nonmarketable, but they are redeemable at par at any time; three months' interest is forfeited if the bonds are redeemed in less than five years. Interest is compounded monthly and accrues for up to 30 years. Investors are limited to purchasing $30,000 of Series I savings bonds per year. Series I bonds have one other unusual feature, which they share with Series EE savings bonds: the interest realized on redemption can be exempted from taxation if it is used for college tuition expenses. That tax-free redemption feature is available to households with an adjusted gross income of less than roughly $80,000; above that amount, the tax-free option is phased out until it is completely eliminated for AGIs exceeding roughly $110,000.

The features of various forms of bonds are listed in table 10-9. The primary advantage of Series I bonds for retirement accumulators holding bonds in a CSA is their tax-deferred status. The combination of zero coupon status (and therefore no reinvestment risk) and redeemability at par at any time up to 30 years also is an advantage. Neither TIPS nor I bonds are completely inflation protected when they are held in a CSA because the taxable interest increases with inflation and therefore the after-tax real return is lower at higher rates of inflation. In a TDA, either TIPS or Series I bonds offer a true inflation-indexed real return. Currently I bonds yield 40 basis points less than TIPS. Given that modest interest-rate discount, I bonds (with their tax-deferred feature) would result in more long-term wealth accumulation than TIPS for investors holding bonds in a CSA, while TIPS could generate greater long-term wealth accumulation in a TDA. Holding I bonds in a TDA would render the tax-deferral feature of the bonds worthless.

We repeated the asset location computations with the historic returns used above by replacing the municipal bonds in the taxable CSA with Series I bonds and the corporate bonds in the TDA by TIPS.[20] We assumed in the base case a real return of 3.6 percent for I bonds and a 4 percent real return for TIPS, which corresponds closely to the current real yields. Care should be used in

20. Series I bonds currently are available only with a maximum maturity of 30 years. Our computations assumed that the tax on those bonds could be deferred until retirement. The benefits of holding I bonds would decrease if taxation of the bond returns could be deferred for only 30 years.

Table 10-9. *Features of Various Types of Fixed-Income Securities*

Feature	*Corporate bonds*	*Municipal bonds*	*TIPS*	*Series I bonds*
Inflation protection	No	No	Yes	Yes
Call option	Callable	Callable	Noncallable	Noncallable
Coupon or zero	Coupon and zeros	Coupon and zeros	Coupon	Zeros
Marketability	Market traded	Market traded	Market traded	Nontransferable; redeemable at par
Maturity	Fixed	Fixed	Fixed	Flexible (up to 30 years)
Taxation	Federal, state, and local taxation	Can be exempt from all taxation	Federal taxation only; exempt from state and local tax	Tax deferred; exempt from state and local tax
Accumulation limit	None	None	None	$30,000 per year
Special features	None	None	None	Tax-free if used for college tuition by qualifying households

comparing earlier results with these. Previous results were based on actual real returns of bonds, whereas these are based on hypothetical real returns for inflation-protected bonds and the returns are held at their current level for the entire sample period. Corporate bonds had a real return of only 2.7 percent between 1962 and 1998, while the simulations reported here assume that indexed bonds offered a 4 percent real return.

Table 10-10 summarizes our findings when we used historic returns on equity mutual funds and allowed investors to hold inflation-protected bonds with three different assumptions about the real yields. Panel C shows the accumulated real wealth levels in the base case with a real return of 3.6 percent for Series I bonds and a 4 percent real return for TIPS. On average, the Defer Stocks First rule outperformed Defer Bonds First by 5.3 percent for a high-tax investor and by 6.1 percent for a medium-tax investor. Those gains are similar to the ones in table 10-3 with nominal bonds. With inflation-protected bonds, Defer Stocks First was relatively more beneficial for medium-tax individuals than for high-tax individuals. The tax advantage of I bonds over stocks was greater for medium-tax investors than for high-tax investors. Defer Bonds First was again superior for the index fund.

Table 10-10. *Asset Location Results with Inflation-Protected Bonds*[a]

	High-tax individual			*Medium-tax individual*		
Type of fund	*Wealth at retirement (Defer Stocks First)*	*Wealth at retirement (Defer Bonds First)*	*Relative wealth*	*Wealth at retirement (Defer Stocks First)*	*Wealth at retirement (Defer Bonds First)*	*Relative wealth*
A. RI = 2.6% RT = 3.0%						
All actively managed funds	82.88	77.80	1.064	92.72	86.37	1.072
Top five actively-managed funds	78.60	75.04	1.048	88.08	82.98	1.062
Index fund	88.30	91.28	0.967	99.14	99.00	1.001
B. RI = 3.1% RT = 3.5%						
All actively managed funds	86.90	82.01	1.059	97.43	91.20	1.066
Top five actively managed funds	82.26	78.97	1.042	92.42	87.56	1.056
Index fund	92.50	96.34	0.960	104.09	104.85	0.993
C. RI = 3.6% RT = 4.0%						
All actively managed funds	91.15	86.51	1.053	102.42	96.36	1.061
Top five actively managed funds	86.15	83.11	1.037	97.02	92.44	1.050
Index fund	96.85	101.68	0.953	109.28	110.97	0.985

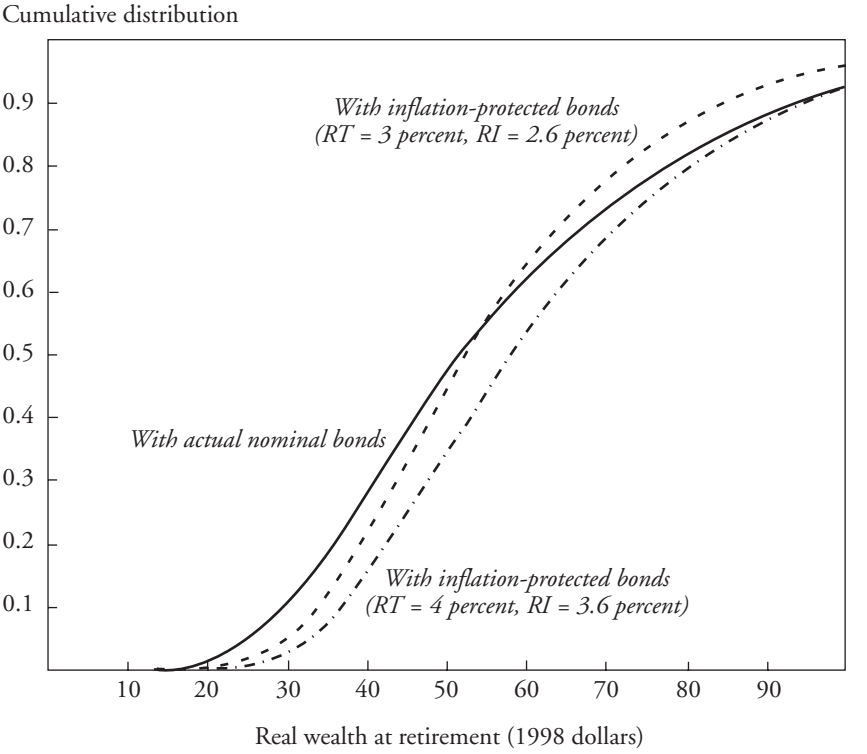
a. This table reports the average wealth levels of the two location strategies if the real return of the bonds is changed. RT denotes the real return of TIPS; RI denotes the real return of Series I bonds. The base case is summarized in panel C.

Panels A and B of table 10-10 report the average wealth levels at retirement for different real yields of the inflation-protected bonds. Wealth levels decreased as the real yield decreased. However, the Defer Stocks First strategy still outperformed Defer Bonds First for all cases using actively managed mutual funds. The relative advantage of deferring stocks first increased slightly as the real yield of the bonds fell, because sheltering bonds in the tax-deferred account was less beneficial if bonds paid a lower yield. Holding the passively managed index fund in the CSA continued to generate higher after-tax wealth at the end of the period than holding the fund in the TDA.

The most significant benefit of TIPS and Series I bonds is protection against inflation. To quantify that benefit, we performed bootstrap simulations with the two real securities. We used the same method that we used in the previous simulations, although randomization was irrelevant for the real yields on the inflation-protected bonds since we assumed that those yields were fixed.

Figure 10-6 depicts the wealth distribution at retirement for a high-tax individual investing for 37 years in the largest five funds and following the Defer Stocks First rule. The figure shows the cumulative distribution functions for an

Figure 10-6. *Wealth Distribution of Inflation-Protected and Nominal Bonds, Top Five Funds, Defer Stocks First*[a]



a. The cumulative distribution of real wealth at retirement using inflation-protected and nominal bonds is depicted. The investor chooses randomly among the five largest mutual funds in each of the 10,000 bootstrap simulations. Only the wealth levels of the strategy Defer Stocks First are shown. The wealth levels with inflation-protected bonds are shown for real returns of RT = 3 percent and RT = 4 percent for TIPS and RI = 2.6 percent and RI = 3.6 percent for Series I bonds.

environment with the historic nominal returns on municipal and corporate bonds and with the hypothetical inflation-protected bonds at two different real return levels. The high-return case assumed real returns of 3.6 percent for Series I bonds and 4 percent for TIPS, and the low-return case assumed real returns of 2.6 and 3 percent, respectively. The distribution function for the nominal bonds was exactly identical to the one in figure 10-2. Introducing inflation-protected bonds increased the outcomes at the lower tail significantly. The cumulative distribution function shifted to the left if the bonds had lower real yields.

Table 10-11 summarizes the probability distribution of the two location strategies with inflation-protected bonds with real returns of 3.6 percent (I bonds) and

Table 10-11. *Wealth Distribution with Inflation-Protected Bonds*[a]

	Cumulative distribution						
Type of fund	*0.001*	*0.010*	*0.100*	*0.500*	*0.900*	*0.990*	*0.999*
A. All actively managed funds							
Wealth (Defer Stocks First)	20.54	27.26	38.31	63.01	111.28	198.80	377.03
Wealth (Defer Bonds First)	20.15	26.63	38.47	62.05	101.29	182.25	323.20
Relative wealth	0.742	0.807	0.900	1.018	1.202	1.35	1.444
B. Top five actively managed funds							
Wealth (Defer Stocks First)	20.81	26.15	37.10	58.00	94.50	136.87	173.80
Wealth (Defer Bonds First)	19.92	25.06	37.04	57.01	85.26	115.59	138.19
Relative wealth	0.800	0.844	0.922	1.026	1.194	1.312	1.391
C. Index fund							
Wealth (Defer Stocks First)	22.93	28.41	40.29	65.07	108.25	158.02	208.13
Wealth (Defer Bonds First)	21.67	28.01	42.09	67.18	103.16	145.13	178.67
Relative wealth	0.746	0.783	0.862	0.975	1.156	1.251	1.307

a. The probability distribution of the real wealth levels of a high-income individual is shown for the two location strategies. Individuals randomly chose one equity fund initially and contributed as described in table 10-3. The returns of the assets were bootstrapped 10,000 times. The annual real return of I bonds is 3.6 percent and of TIPS is 4 percent.

4 percent (TIPS). Panel B of table 10-11 summarizes the probability distributions of the two location strategies for a high-tax individual investing in one of the top five funds. The two functions were quite close at low wealth levels, but Defer Stocks First dominated Defer Bonds First at higher wealth levels. Defer Stocks First usually dominated Defer Bonds First for the actively managed mutual funds but not for the passively managed index fund. Comparing panel B of table 10-7 with the same panel in table 10-11 shows that the wealth level increased with the Defer Stocks First strategy by 34.4 percent at the 1st percentile and by 23.9 percent at the 10th percentile. It was almost identical at the 90th percentile and decreased by 11.8 percent at the 99th percentile.

Table 10-12 shows certainty equivalent results like those in table 10-8, although now we allow for index bonds. Comparing this with table 10-8 shows that the certainty equivalent of an investor with a risk aversion of 3 who invested in the top five funds increased by 19.4 percent when real rather than nominal bonds were available. Risk-averse investors value protection against inflation because they put a much higher weight on the lower tail of the probability distribution. The certainty equivalents from table 10-12 indicate that deferring stocks first was preferable to deferring bonds first at all listed levels of risk aversion for the actively managed mutual funds. The opposite held for the index fund unless individuals were extremely risk averse. By comparing panel C

Table 10-12. *Certainty Equivalents with Inflation-Protected Bonds*[a]

	Coefficient of relative risk aversion				
Type of fund	*0*	*1*	*3*	*5*	*10*
A. All actively managed funds					
CE (Defer Stocks First)	70.93	64.41	54.87	47.97	36.81
CE (Defer Bonds First)	67.88	62.58	54.18	47.40	35.76
Relative CE	1.036	1.029	1.013	1.012	1.029
B. Top five actively managed funds					
CE (Defer Stocks First)	62.62	58.62	51.69	46.03	35.97
CE (Defer Bonds First)	59.54	56.52	50.64	45.13	34.56
Relative CE	1.052	1.037	1.021	1.020	1.041
C. Index fund					
CE (Defer Stocks First)	70.52	65.57	57.036	50.25	39.04
CE (Defer Bonds First)	70.62	66.50	58.56	51.26	38.35
Relative CE	0.992	0.986	0.974	0.980	1.018

a. Table summarizes the certainty equivalents (CE) of the bootstrap simulations for the two location strategies using a constant relative risk aversion (CRRA) utility function.

in table 10-12 with the other two panels, we again see that using the index fund usually had a higher certainty equivalent outcome than using a randomly selected actively managed fund.[21]

Conclusion

Our findings suggest that asset location decisions are very important for retirement accumulators who hold assets in both tax-deferred pension accounts and in taxable saving accounts. The improvement in the average or certainty equivalent outcome from following an optimal asset location strategy can be as high as 9 percent. With particular actively managed funds, the ex-post gain can be as high as 17 percent.

Our results suggest two conclusions regarding the after-tax wealth that high-income and medium-income investors would have accumulated over the 1962–98 period if they had invested in both stocks and bonds and held assets in both pension and taxable accounts. First, if an investor invested in stocks

21. In results not reported here, we explored the importance of asset location for investors with different desired stock-bond holdings in an environment with inflation-indexed bonds. As in the case with nominal bonds, optimal asset location was most important for an investor who was planning to hold a nearly equal mix of bonds and stocks.

through an actively managed equity mutual fund like the ones we consider, then after-tax wealth was maximized by holding as much of the equity mutual fund as possible in the pension account. Such an investor would have held corporate bonds in the pension account only if there was room for them, while holding municipal bonds in taxable accounts. Our results are based on a small sample of actively managed equity mutual funds that were available for our entire sample period, but we suspect that they would apply to most other actively managed funds available during the last four decades. Second, an investor who used a passively managed equity index fund for stock investments would have accumulated wealth most quickly by first locating corporate bonds in the tax-deferred account and holding the index fund in the taxable account.

Our results show that the tax burden that equity mutual funds, particularly actively managed funds, impose on their investors and the availability of both municipal bonds and inflation-protected Treasury securities as alternatives to corporate bonds need to be factored into the asset location strategy. At least historically, most actively managed equity funds imposed an effective tax rate on their shareholders that was higher than the implicit tax on municipal bonds. Therefore the gain from holding a typical actively managed fund in a TDA rather than a CSA was greater than the gain from holding a corporate bond in a TDA rather than a tax-exempt bond in a CSA. This analysis is reversed with index funds, although it appears that the stakes from optimal location are lower in that case. Passively managed index funds impose a low enough tax burden on their investors that what they gain from being held in a pension account is less than the after-tax yield differential of corporate bonds over municipal bonds.

Even though it was not our purpose to enter the debate over actively managed and passively managed equity funds, our simulations do shed light on the relative advantage of the two fund types for someone saving consistently over 37 years. Our bootstrap simulations indicate that a risk-averse retirement accumulator would have fared better overall with an index fund held in a taxable setting than with a randomly chosen actively managed fund held in a tax-deferred account. Of course, the historical pattern may provide only limited insight on future patterns of returns.

One important issue that arises in using historical results to predict the future concerns the extent to which managers of actively managed funds recognize the tax consequences of their decisions for taxable investors. If they become more aware of taxes in the future—as the recent emergence of tax-managed funds and other financial products that are designed to reduce investors' tax burden suggests that they might be—then our findings may be attenuated. Although the financial press today devotes some attention to the question of how taxes affect after-tax mutual fund returns for individual investors, tax-managed mutual funds currently account for less than 1 percent of the total assets held by equity mutual funds. If the tax efficiency of a typical actively managed equity fund

improves in the future, it could have important implications for the future applicability of our analysis.

While most of our analysis concerns a rule-of-thumb, fifty-fifty stock-bond asset allocation, we did look at the outcome for different allocations in our bootstrap simulations. Not surprisingly, an investor's optimal asset allocation is a function of his or her risk aversion. Still, given the well-known equity premium puzzle and the fact that even our bootstrap results were based on realized returns from 1962 to 1998, mildly risk-averse retirement investors would have achieved their highest certainty equivalent outcomes by allocating substantially more than 50 percent of their portfolio to stocks. Whether such results will obtain going forward is not clear.

We also looked at the asset location issues associated with the relatively new inflation-protected Treasury bonds such as TIPS and Series I savings bonds. TIPS have a real coupon rate and an inflation-adjusted principal amount; both the coupon and the principal adjustment are taxable income. Series I bonds are zero coupon inflation-protected bonds; taxation is deferred until sale. Given those features, inflation-linked securities pose their own location question. Our results suggest that the answer depends on the type of equity mutual fund that the investor holds. If index bonds had been available for the last four decades and their yields had been similar to those on current index bonds, then investors would have generated more wealth by holding actively managed funds in a pension account (with Series I bonds held outside) than by following other strategies for those funds. Investors who wished to hold index funds, however, would have accumulated more wealth by holding them outside their retirement accounts, with TIPS in their pension accounts.

COMMENT

Leslie E. Papke

In an important contribution to the pension finance literature, both Fischer Black and Irwin Tepper noted that firms that offer a defined benefit (DB) pension plan could choose to hold the assets in their pension plan account—a tax-deferred account—or outside the pension plan in the corporate account, where the income would be fully taxable.[1] They concluded that more heavily taxed assets should be held in the pension plan account and the less heavily taxed assets in the taxable corporate account. Since the view was that corporate bonds generally were taxed heavily relative to stocks, their advice implied that bonds should be held in the corporate DB plan and equities in the corporate account. This investment strategy—bonds inside and stocks outside—became the conventional wisdom.

As participant-directed defined contribution (DC) plans have become common, plan participants who also save outside their pensions face an analogous asset allocation problem: if they plan to hold both stocks and bonds, should they hold predominantly stocks in their tax-deferred plan or should they defer bonds first?

In this chapter, Poterba, Shoven, and Sialm consider plan participants who want to hold half of their assets in fixed-income securities and the other half in equities. The authors' contribution lies in noting that actively managed equity mutual funds often generate substantial tax liability and that tax-free municipal bonds are also available. They calculate returns to two strategies: the first gives preference to stocks in the tax-deferred account, a 401(k) plan, for example; the second gives preference to bonds. By calculating the end-of-period returns using historical data from 1962 to 1998, they demonstrate that the stock-bond distinction in the traditional Black-Tepper recommendation is too general.

The following are their major conclusions:

—If investors choose to hold actively managed equity mutual funds that generate substantial tax liability, their total return will be higher if they hold those funds in their 401(k) plan and tax-free municipal bonds outside. For the twelve actively managed funds, the average gain from this strategy (deferring stocks first) is 8.9 percentage points for investors with high marginal tax rates. Essentially, the actively managed funds result in a higher effective tax rate for high-income investors than the implicit tax rate on municipal bonds.

Including municipal bonds as an investment option plays a key role in this result. If investors are limited to corporate bonds, then deferring bonds first—

1. Black (1980); Tepper (1981).

the usual Black-Tepper recommendation—outperforms the other strategy for nine of twelve actively managed equity funds.

—If investors choose to hold a passively managed equity index fund like the S&P 500 index, which is more tax efficient, the conventional wisdom wins—returns are higher if bonds are held in the 401(k) account and stocks outside. The difference in returns from the two strategies is smaller in this case, only 1.7 percentage points. Passively managed funds are sufficiently tax efficient that they gain less from the pension environment than the premium of corporate bond yields over municipal bonds.

—If investors also choose to hold U.S. government inflation-indexed bonds, the basic results in one and two above are unchanged. The strategy with the highest return depends on which type of equity stock fund is held.

This chapter provides a thorough demonstration of the high tax costs incurred by actively managed equity mutual funds. These tax costs are high enough to reverse the traditional investment advice that bonds should be held in a tax-deferred pension plan and stocks outside (if the investor is willing to hold municipal bonds as well). The tax consequences of churning are often discussed in the newsletters of some investment companies, but the numerical results in this chapter quantify how large this difference can be over a thirty-seven-year time horizon.[2]

This exercise also usefully demonstrates the efficiency of the equity index fund. If an investor holds this type of fund, the preferred strategy would have been to hold it outside the pension account, but with either strategy the difference in returns would have been under 2 percentage points. Further, bootstrap simulations indicate that risk-averse investors would have fared best historically with an index fund held outside their pension plan than with a randomly chosen actively managed account held in their plan.

Although the chapter has no clear policy implications, it does give useful cautionary information to high-income investors with pensions: that actively managed equity funds should be considered heavily taxed and therefore held in tax-deferred accounts. Investors can simplify their lives if they hold an index fund instead—whether this type of fund is held inside the pension plan or outside is much less important. This may have relevance for plan participants who have limited choice, or no choice at all, in their pension asset allocation.

The focus of the chapter is the finding that if an investor chooses to hold an actively managed equity index fund, then—if he or she is also willing to hold municipal bonds—returns to the stocks inside/bonds outside strategy would maximize after-tax returns. In my comments on the original version of this

2. See, for a recent example, Vanguard Group, "For Investors, Increased Activity Translates into Lower Returns," *In the Vanguard* (Summer 2000).

chapter, I discussed two reasons why one might expect the future differences in returns from the two strategies to narrow in this case. First, high marginal tax rates magnify the difference between using a tax-deferred versus a conventional savings account, and marginal tax rates were relatively high over this period. The rapid inflation of the 1970s and early 1980s (see figure 10-1) led to bracket creep, driving individuals into higher tax brackets and diminishing the real value of the personal exemption and deductions. The average marginal tax rate rose from 21 percent in 1975 to 27 percent in 1981 without legislated increases in rates.[3] Average marginal tax rates were higher in 1981 than in any other year from 1962 to 1995. The 1981 Economic Recovery Tax Act substantially reduced marginal tax rates and provided for bracket indexing in 1985. So, there was no bracket indexing for twenty-four of the thirty-seven years analyzed here.

The authors test the sensitivity of their results to alternative tax rates first by applying 1998 tax law to the 1962–98 returns, but since they are unable to calculate the substantial general equilibrium effects on the before-tax returns, this comparison is of limited usefulness. It is not possible to suggest a path of tax rates that might be more typical since any choice would be arbitrary. My point is not to quibble about the typical path of future tax rates, only to argue that we are unlikely to see a return to the rates that prevailed before brackets were indexed.

The authors, noting that their findings may be sensitive to the particular pattern of equity and bond returns that occurred over the period, simulate returns to equity mutual funds, drawing sequences of thirty-seven returns with replacement and doing 10,000 replications. Since they sample actual empirical returns and do it 10,000 times, they find, on average, what they found earlier, although the difference in strategies is a bit smaller.

A second reason to expect that the differences between the two strategies will narrow when an actively managed equity fund is held is that funds are expected to become more tax efficient. With the rise in participant-directed individual accounts, information on investment funds and their tax consequences is proliferating. Patrick McGeehan and Danny Hakim profiled fund managers and brokerage firms that offer customized baskets of stocks called folios.[4] These folios can be created to be tax efficient, so they need not be held in a pension fund. Innovative investment management firms will find it profitable to offer wealthy clients customized, tax-efficient equity funds.[5] Indeed, a shift to more tax-efficient funds than the ones studied here may already have occurred. Their

3. See Auerbach and Feenberg (2000).

4. Patrick McGeehan and Danny Hakim, "Two Fund Giants to Introduce Self-Directed Portfolios for Investors," *New York Times*, February 14, 2001, pp. C1–2.

5. For example, see the discussion in TIAA-CREF, "TIAA-CREF Trust Company Brings Personal Touch to Investment Management," *Institute Forum*, vol. 4 (September 2000), pp. 1–5.

Table 10-13. *Nonpension Investment in Stock*[a]

Pension asset holdings	*Percent of nonpension financial assets in stock*			
	Mean	*10th percentile*	*25th percentile*	*50th percentile*
Nonpension investment in stock by pension asset allocation				
Mostly stock	87.66	49	89	100
	(24.71)			
Mostly bonds	87.10	12.28	100	100
	(30.52)			
Even split	91.70	75	100	100
	(23.00)			

Pension asset holdings	*Percent of stock held outside based on income of*		
	< $30,000	*$30,000–$60,000*	*> $60,000*
Nonpension investment in stock by income and pension asset allocation			
Mostly stock	77.65	84.37	89.39
	(44.00)	(30.76)	(20.97)
Mostly bonds	66.67	85.75	91.14
	(51.64)	(32.80)	(24.13)
Even split	92.86	96.49	88.42
	(26.73)	(15.86)	(25.73)
Observations	25	90	187

Source: Author's tabulations of the 1992 Health and Retirement Study in 1994.

a. The unconditional frequency distribution of the three asset categories in pension plans is mostly stocks (26.90 percent), mostly bonds (25.99 percent), and even split (47.11 percent). Nonpension financial assets equal the sum of household holdings of net stocks and bonds.

sample of funds represented about one-third of the total value of mutual funds in the 1960s, but by 1998, the sample had fallen to only 2.2 percent of the market.

The authors acknowledge this point in their revision but add that the so-called tax-managed funds are still a small part of the equity market. However, tax-managed mutual funds plus the individualized folios should offer plenty of opportunities for tax-efficient investments for wealthy, tax-savvy investors.

Finally, to see what sort of investment patterns can be observed in individual data, I tabulate investment information from the 1992 Health and Retirement Study. The study reports three choices for pension assets for participants of defined contribution plans with choice over their asset allocation: mostly stocks, mostly bonds, or an even split. Respondents also were asked about the net worth of financial assets held outside their pension funds: "Excluding IRA and

Keogh accounts, do you own shares of stock in publicly held corporations, mutual funds, investment trusts? Do you own corporate, municipal, government, foreign bonds, or bond trusts?" The responses relating to participants' primary defined contribution plan indicate that of those with DC plans, 712 participants reported choice over their asset allocation and 738 reported no choice.

First, I find that pension participants with outside stock or bond investments were clearly better off. Mean household income in 1991 for those who held assets outside was $98,712.18 (standard deviation of $111,962), with a median of $73,000 (319 observations). Those who had no outside stocks and bonds had mean household incomes of $58,186 (41,766), with a median of $50,000 (393 observations).

The unconditional frequency distributions of the three asset categories in pension plans are 26.90 percent mostly stocks, 25.99 percent mostly bonds, and 47.11 percent even split. In table 10-13, I sum up the value of stocks and bonds held outside the pension fund and present the three pension holding categories by the percent of stock held outside. It appears that regardless of how a pension is allocated, predominantly stocks are held outside. Further, a regression of the percent of stock held outside on dummies for the pension asset allocation categories, plus a quadratic in income, shows no relationship between the allocations. Of course, these data are crude—they cannot distinguish the types of equity funds or bonds held. But it appears that only about 26 percent of participants could be following the traditional prescription.

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